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Final Report--Objective I, Task 2

December 1987

INTUITIVE DATA SORTING

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SRI Project 1291

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ABSTRACT

The Intuitive Data Sorting (IDS) model posits that humans may have an ability to produce a psychoenergetically mediated sampling bias when designing and conducting experiments that rely on the use of statistical analyses. If this is true, it would have profound implications, since much of our current knowledge is based on such studies. The IDS theory would imply that an experimenter or subject can produce this bias in such a way that the results of the experiment support the hypothesis of interest, even if it is not true.

Experiments to try to test this theory were conducted at SRI International in FY 1984 and FY 1986. The FY 1984 experiment involved only two subjects, but the results from each one supported the IDS model. The FY 1986 experiment never passed the pilot phase, because only one subject was identified who could consistently exhibit this ability.

The computer program used to test the theory was substantially revised in FY 1987, to more accurately measure the window of time in which the ability might operate. Unfortunately, the subject who performed significantly in both previous studies was not available to participate. The only other subject who had performed significantly in FY 1984 agreed to participate, but dropped out before the study was completed. Two novices also participated.

Because of the previous results, the unavailability of reliable subjects for this year's study, and the important implications of the IDS theory, it is recommended that the experiment be continued at a later date. The new version of the computer program, developed this year, should be used in future studies.

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I INTRODUCTION AND BACKGROUND

A. The IDS Theory

Since 1979, SRI has been working on the development of a model that could account for a large body of experimental data both in the parapsychological literature and in other disciplines. This model, called Intuitive Data Sorting (IDS), posits that experimental results in many cases may contain a psychoenergetically mediated sampling bias.* In other words, human experimenters may have an ability to make decisions regarding their experimental protocol in such a way that the underlying population is *not* sampled in a truly random fashion, but rather with a bias favoring the experimental hypothesis of interest. This bias could enter the experiment whenever a human decision is made. For example, most studies that rely on statistical analyses involve some sort of randomization scheme. Decisions about how to conduct the randomization, what seed number to use, etc., are all under the control of the experimenter. The IDS Theory suggests that these decisions might be made in such a way that the experimental results are favorable, not because an effect really exists, but because the data were sampled in a biased way.

In 1969, Schmidt[1]† introduced a type of psychoenergetic experiment in which individuals were asked to "modify" the statistics of "true" random number generators (RNG), i.e., devices that generate sequences of numbers based on some fundamental random process such as radioactive decay or thermal noise. Since publication of that important initial paper, hundreds of similar studies have been conducted in a variety of laboratories. An analysis of the combined results showed that the probability that the observed deviations occurred by normal statistical fluctuations alone was $p \leq 3.9 \times 10^{-18}$ during experimental conditions, and $p \leq 0.78$ under control conditions.[2] Clearly, there is a statistical anomaly within these data.

Since 1969, there has been considerable discussion about mechanisms that can explain these RNG results.[1,3,4] The most frequently proposed explanation is remote action (RA). Under the RA hypothesis, by definition, a participant "forces" a physical modification in a source of random signals so as to produce a change in the output statistics. However, with the IDS hypothesis, we propose that humans can make decisions (by psychoenergetic means) to take advantage of the natural and unperturbed fluctuations of a system. In the context of an RNG

* This report constitutes the deliverable for Objective I, Task 2.

† References are listed at the end of this report.

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experiment, it appears that individuals can anticipate locally deviant subsequences from within larger and unperturbed sequences and make decisions based upon that knowledge. Suppose that an individual is asked to "make" the RNG produce more binary ones than zeros. Rather than "causing" the device to produce binary ones, we suggest that the participant has simply initiated the data collection by anticipating when the RNG was going to produce a series of ones as part of its natural binomial fluctuation. Thus, the participant has capitalized upon natural events, rather than "causing" anything to occur.

To obtain this information from a system that is changing in time, an individual would need access to future events. While there are specific examples from physics that could be interpreted as information propagating backward in time, the idea that it is possible at the macroscopic level is *not* generally accepted.

Since the late 1930s, however, the parapsychological research journals have been reporting evidence that information from the future *is* available in the present, and that some individuals have the ability to perceive it. This ability is called precognition. In most cases the information perceived is above what would be expected by chance guessing, but it is not extremely accurate. Thus, while there is some evidence that information is available, it appears to be probabilistic in nature, and not deterministic. In other words, some future events, while not predetermined, appear to be more likely than chance would dictate, and this information seems to be available at times.

In summary then, the IDS theory suggests that a subject or experimenter may be able to obtain information about the probabilities of various future outcomes, and may be able to use that information to select a biased sample which will produce the experimental results desired.

Because large bodies of research have derived conclusions about cause-and-effect relationships from statistical hypothesis testing, it is important to determine if our IDS model has any scientific basis. The first attempt along these lines was to compare the predictions of the IDS model to those of the RA model for the RNG experiments described above, using a large data base of such experiments.[5]

It appeared that the data were described by the IDS model rather than the RA hypothesis. There were problems, however, because in the test devised to separate the two conditions, the IDS formalism was derived from the assumption that each string of data resulted from a *single* press of a button. However, *none* of the experiments in the data base were reported in that way. Instead, all of the data were aggregates over many button presses. While we were able to draw conclusions based upon averaged data, (e.g., on the average, IDS appears to account for the

results in the historical data base), the ideal test of IDS must be conducted using data resulting from single button presses.

B. IDS Experiments at SRI International

1. Design and Rationale

In order to test the IDS model in the laboratory, an experiment was devised using a pseudorandom number generator (PRNG). Since no evidence has been put forth to support the idea that putative RA could influence computer hardware, it was assumed that RA could be ruled out as an explanation of any anomalous results.

The idea of the experiment was to collect sequences of binary digits of varying lengths, by having a subject push a button to initiate the collection of each sequence. For each button press, a z-score would be computed to see if the proportion of zeros and ones deviated significantly from what would be expected by chance. The subject was told only that he/she should try to achieve a high z-score.

If the IDS theory is correct, subjects should be able to achieve z-scores that on the average are higher than expected by chance. However, the magnitude of these scores should *not* increase as the sequence lengths increase, as they would if RA were in effect. Conversely, the *proportion* of ones (or zeros) should approach closer to the expected 50% as the sequence length increases. This is because we are positing that subjects have an ability to press the button when a deviant sequence is about to occur. Thus, for example, in a sequence of ten coin flips it would not be uncommon to observe eight or nine (80 to 90%) heads. But in a sequence of 100 coin flips it would be extremely unusual to observe 80 or 90 heads. A z-score of 2.9 would result from ten heads out of ten flips, but the same z-score would be achieved with only 65 heads out of 100 flips.

This suggests that a test of the IDS model could be achieved by comparing z-scores across sequence lengths. Or, equivalently, the test could examine the proportion of zeros and ones as a function of sequence length. This proportion should steadily approach 50% as the sequence length collected at one button press increases.

This formulation can be turned into a linear model by transforming to logs. Let $|\Delta p|$ represent the absolute difference between the proportion of ones and 0.50. Then, by algebraically manipulating the formula for a z-score, we obtain:

$$\ln |\Delta p| = \ln |z| - \ln 2 - 0.5 \ln n.$$

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This suggests that if the IDS assumption is correct, and the magnitude of z remains constant across sequence lengths, then a plot of ln $|\Delta p|$ versus ln n should result in a line with a slope of -0.5 and an intercept of $\{ E (\ln |z|) - \ln 2 \}$. If the magnitude of z changes with the sequence length, then the slope of the line will no longer be -0.5, because the term $E (\ln |z|)$ will be a function of n. In fact, the relationship between ln $|\Delta p|$ and ln n may no longer be linear. On the other hand, if mean chance expectation (MCE) results, then the slope will still be -0.5, and the intercept can be computed using the appropriate integrals. Finally, if IDS is operational, then the $E (\ln |z|)$ will be larger than it would be under MCE, while retaining a slope of -0.5.

2. Experimental Results

The first experiment done at SRI International using this framework was reported in 1985 by Radin and May.[6] Two subjects (I.D. 105 and I.D. 531) who had been successful at similar tasks participated. Both individuals showed independently significant evidence for IDS by producing lines with intercepts significantly greater than predicted by MCE ($p < 0.005$ for each participant), but slopes which were not significantly different from -0.5.

During the FY 1986 program, we planned to conduct the experiment in two phases: a screening and an experiment phase.[7] For the pilot phase, we asked 20 individuals to contribute 100 trials each with sequence lengths varying from 101 to 100001. All but four of them completed this task. For availability reasons, the four participants contributed varying numbers of trials (less than 100). We had decided to select seven individuals from within the pilot group to participate in a formal PRNG IDS experiment. The criterion for being included in the formal group was that the participant had to produce a significant increase above MCE of the variance of the z-score distribution over 100 trials (the MCE variance = 1.0).

Of the 16 participants who finished the 100 trial series, only Subject 531, met the above requirement (variance = 1.37, $p < 0.008$). The second best performer, however, produced a variance of 1.21 ($p < 0.07$). Judging from the 1984 study, we would not expect to see a significant intercept with only 100 trials, and none were observed.

While it was particularly interesting that Subject 531 maintained his/her consistent performance, we felt that we should continue the screening until we were able to select seven participants who scored significantly during this pilot phase. Thus, a formal experiment was not conducted in FY 1986.

II METHOD OF APPROACH

A. Details of Computer Program

The experiment was modified for FY 1987, to examine a conclusion that had been made on the basis of incorrect reasoning in the 1985 report.[5] In that report, it was concluded that humans would have to time the moment of the button press to within 20 milliseconds (ms) to achieve the observed results. The conclusion was based on comparing z-scores collected at the *moment* of the button press with those that would have been collected if the button had been pressed from one to five "clock ticks" (20 ms per clock tick) *sooner* or *later*. It was shown that of the eleven sets of z-scores and sequences lengths generated this way, only the set at the actual time of the button press would have produced the observed significant results. Thus, if the subject had *always* been off consistently by as little as 20 ms in one direction or the other, the results would have been at chance.

This is an interesting observation, but it does not necessarily imply that the subjects must be accurate to within 20 ms to achieve significant results. The reason for this is that the z-score at each "clock tick" is based on the seed generated at that point. Therefore, pushing the button at adjacent clock ticks will *not* result in highly overlapping binary sequences. A completely separate binary sequence will be generated from each seed. So the IDS task requires the subject to anticipate the time at which a seed is present that will produce a good binary sequence, and *not* the time at which a rapidly moving binary sequence is about to produce an overabundance of zeros or ones. Thus, z-scores generated by adjacent clock ticks should not be correlated. It was therefore impossible to tell what would have happened if the subject had consistently pushed the button at *almost* the right time.

For FY 1987, the experiment was modified so that if the subject pushed the button at a clock tick which was *close* to one which would produce a significant z-score, then the resulting z-score would be *close* to significance. In this way, if IDS is operating, and if timing is exact to within 40 ms, a histogram of z-scores for the experiment should produce a spike in the significant range. On the other hand, if timing is approximate, the z-score histogram should show a gradual increase in frequency as significance is approached.

To achieve this goal, "seed catalogs" for each sequence length were created by computing the actual z-score corresponding to each of the $2^{15} - 1 = 32,676$ possible seeds. From these, four catalogs were computed. The first catalog contained all seeds that would produce a significant z-score, and thus contained 5% of the seeds. The second catalog contained the next 10%, the third catalog contained the next 20%, and finally, the fourth catalog contained seeds that would produce z-scores in the middle 65% of the distribution.

Each trial in the experiment would proceed as follows:

(1) The subject presses the button and generates a seed. Seeds are in numerical order (but the corresponding z-scores are not), so a button press one tick (about 20 ms) sooner or later would result in a seed of one more or less than the one generated.

(2) A random integer increment between 0 and 39, generated previously, is added to the seed. Call this sum S. The purpose of this step is to eliminate an artifact based on the subject knowing how long it takes the clock to cycle through 20 seeds. As will be seen momentarily, this knowledge coupled with exquisite timing would allow a subject to continue to generate significant z-scores once the first one had been generated.

(3) An integer from 0 to 19 is derived, using the formula:

$$I = \text{integer}\ [\ (S \bmod 40)\ /\ 2.0\ ].$$

(4) I is used to choose a seed catalog using the scheme shown in Table 1. Note that the magnitude of the z-score depends on the absolute distance of I from zero; this is equivalent to the number of clock ticks away from a "significant seed" the button was pressed. Thus, partial credit is given for being close in timing.

(5) A z-score is randomly chosen from the selected seed catalog. This ensures that all z-scores will be chosen with the correct probabilities, since those closer to the mean will occur more often in the seed catalog.

(6) The subject is shown feedback in the form of two "thermometers" displaying the z-score and corresponding p-value. Also, a running tally is shown representing the test of whether or not the variance of the z-scores generated so far exceeds the expected value of 1.0, with a diagonal line representing the 10% significance level. Finally, a histogram of the absolute values of the z-scores generated in the current set of 50 trials is displayed. The subject therefore has a choice of feedback information on which to focus. See Figure 1 for an example of the computer display following the button press for trial 42.

(7) The z-score, I, and information such as date and time are stored for future analysis.

(8) The next trial begins. The screen is cleared at the end of each set of 50 trials.

Table 1

Z-SCORE AS A FUNCTION OF CLOCK TICKS FROM CLOSEST SIGNIFICANT SEED

I	Distance from I = 0	Seed Catalog	Percent of z-scores
0	0 ticks	1	extreme 5%
1, 19	1 tick	2	next 10%
2, 3, 17, 18	2 or 3 ticks	3	next 20%
4 to 16	4 or more ticks	4	middle 65%

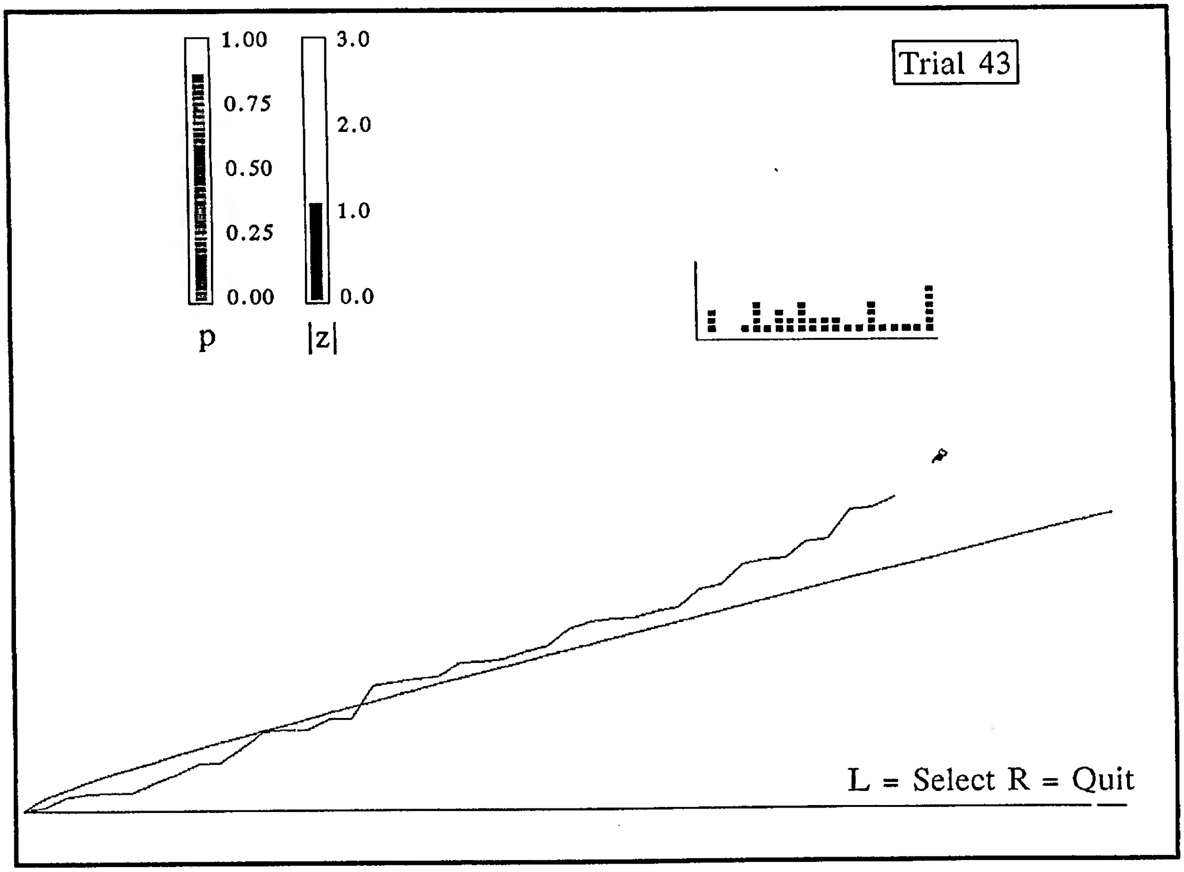

FIGURE 1 IDS GAME COMPUTER SCREEN DISPLAY

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B. Selection and Testing of Subjects

Since this experiment had been tested on a limited basis only, there was no available pool of subjects who had been successful in the past. In FY 1984, both subjects who were tested (Subjects 105 and 531) produced significant results, but in FY 1986 the only significant result was produced by Subject 531, even though 16 subjects were tested.

Subject 531 was unavailable to participate in the FY 1987 experiment. Two novices (Subjects 235 and 908) and Subject 105 were recruited. Each participant was asked to contribute 600 trials (button presses). The two novices finished the experiment, but Subject 105 dropped out after completing only 500 trials. In accordance with SRI's human use guidelines, subjects have the right to discontinue participating in an experiment at any time. This subject was also contributing to remote viewing experiments during the same period.

The version of the computer program used for this experiment generated three different sequence lengths, 101, 3279, and 100001. (The log of the middle number is halfway between the logs of the other two.) These were randomly assigned such that each one would occur 200 times if the entire 600 trials were completed.

C. Analysis

Since this was the first time this study was conducted with this format, the analysis procedure was designed to be exploratory rather than to give a strict confirmation of the theory. Thus, several features of the data were examined for each subject.

The results of the analysis for one participant (Subject 908) are shown in the Appendix. The key features of the analysis, and the results for the appended example, include the following:

(1) Characteristics of the overall set of z-scores produced for all button presses, and a chi-square test of whether or not this set had a larger variance than the 1.0 expected by chance. In the example, chi-square = 619.0780, p = 0.278.

(2) The least squares fit to the pairs ($\ln |\Delta p|$, $\ln n$) over all trials.

(3) The exact slope and intercept expected by chance for these sequence lengths.

(4) The expected and observed averages for $|\Delta p|$ at each of the sequence lengths.

(5) Tests to see if the slope, or intercept, or both for the least squares line deviated from MCE. In the example shown, the p-values for these three tests are 0.913, 0.6565, and 0.9004, respectively. The IDS hypothesis predicts that the intercept will differ from chance, but the slope will not.

(6) A frequency distribution for the z-scores, for the total set, and for each sequence length individually.

(7) The characteristics of the distribution of z-scores produced at each individual sequence length, and a chi-square test for whether or not each of the variances deviates significantly from the expected variance of 1.0. In the example, none of them did.

(8) The values necessary to plot the average ln $|\Delta p|$ and one error bar in either direction on log paper, for each sequence length.

(9) A histogram of the number of times the button was pressed i clock ticks away from the significant seed, where i ranges from −9 (360 ms too early) to +10 (400 ms too late). A significant seed occurred on the average, about once every 800 ms. This range was chosen to cover normal human response times. Also, a chi-square test was made of the hypothesis that the probabilities of the twenty positions were each 1/20. In the example, chi-square = 27.07, df = 19, $p \doteq 0.10$. If IDS were operating, and if the ability also enabled one to push the button at close to the right time, the histogram should peak at bin 0, and steadily decrease as distance from bin 0 increases. This pattern was not evident in the example shown.

III RESULTS AND CONCLUSIONS

None of the subjects in the experiment showed results significantly different from chance on any of the measures tested. The two novices in the experiment never deviated from chance during the course of the study. However, the performance of Subject 105 steadily declined as the experiment progressed. After the first 200 trials had been collected, the p-values for his/her slope and intercept tests, respectively, were 0.313 and 0.002. Further, the histogram of clock ticks showed a significant proportion falling at three ticks before and after the significant seed, representing a displacement of about 180 ms in either direction. These results are reported here only because this individual had performed well in the past. Other than that we ascribe no further meaning to this "related" result.

As mentioned, this subject was concurrently participating in remote viewing experiments. Although he/she had performed exceedingly well in the past, none of the results of the 1987 experiments showed significant psi ability. This subject also dropped out of the remote viewing studies before completion.

If the IDS theory correctly portrays a human ability, the implications would be profound. Parapsychology laboratories continue to produce significant results in RNG studies, and IDS is currently the most plausible alternative to RA. For these reasons, and because of the lack of reliable subjects for the FY 1987 experiment, a compelling argument can be made for continuing this research at a later date.

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APPENDIX

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Sequence Order: 3179, 101, 100001,

(1) Overall Trials = 600
Overall Z-mean = −0.0764
Overall Z-variance = 1.0335
Overall Z-max = 2.9264
Overall Z-min = −3.6816
Overall Chi-sqr = 619.0780 (df = 599)
Overall z(Chi) = 0.5898
Overall p-value = 0.277678 (1-tailed)

(2) LINEAR LEAST SQUARES FIT TO THE DATA

y = a+b(x−xbar): a = −5.3578 +/− 0.0452
b = −0.5097 +/− 0.3929

(3) MCE-LINE: a = −5.3377
b = −0.5080
ybar = −5.3578
xbar = 8.0641

(4) MCE-LINE (n,delta_p): (101 , 2.77e−02)
(3178 , 4.81e−03)
(100001, 8.34e−04)

DATA-LINE (n,delta_p): (101 , 2.73e−02)
(3178 , 4.71e−03)
(100001, 8.12e−04)

(5) SLOPE AND INTERCEPT TEST

Slope (−0.508): F = 0.0119 (df1 = 1; df2 = 598)
Slope : p = 0.913

Intcp (−5.338): F = 0.1980 (df1 = 1; df2 = 598)
Intcp : p = 0.6565

JOINT SLOPE AND INTERCEPT TEST

Joint : F = 0.1050 (df1 = 2; df2 = 598)
Joint : p = 0.9004

(6) TOTAL Z-SCORE DISTRIBUTIONS

Z-Cent	Total	101	3179	100001
-3.3	2	1	0	1
-3.0	0	0	0	0
-2.7	1	0	0	1
-2.4	5	2	2	1
-2.1	12	3	4	5
-1.8	21	5	7	9
-1.5	22	8	5	9
-1.2	35	16	12	7
-0.9	53	10	33	10
-0.6	67	29	12	26
-0.3	55	16	13	26
0.0	81	27	29	25
0.3	61	18	25	18
0.6	56	23	16	17
0.9	47	13	20	14
1.2	37	16	9	12
1.5	22	6	8	8
1.8	8	2	1	5
2.1	7	3	2	2
2.4	6	2	1	3
2.7	1	0	0	1
3.0	1	0	1	0
3.3	0	0	0	0

(7) Z-SCORE by SEQUENCE LENGTH

SQ_L	Trials	Mean	Var	Max	Min	Chi**2	Z_Chi	p_value
101	200	-0.065	0.996	2.289	-3.682	198.292	-0.010	0.5042
3179	200	-0.102	0.969	2.926	-2.323	192.837	-0.286	0.6127
100001	200	-0.062	1.144	2.577	-3.165	227.749	1.418	0.07816

(8)

Lengths :	101	3179	100001
E + 1 sig :	3.017e-02	4.796e-03	9.124e-04
E(ln|dy|) :	2.830e-02	4.395e-03	8.410e-04
E - 1 sig :	2.654e-02	4.027e-03	7.751e-04

(9) IDS Game Reaction–Time Histogram:
Chi**2 = 27.06666667
Chi**2/df = 1.42456140 (df = 19)

```
BIN COUNT
 -9   35 ***********************************
 -8   35 ***********************************
 -7   32 ********************************
 -6   17 *****************
 -5   32 ********************************
 -4   23 ***********************
 -3   31 *******************************
 -2   26 **************************
 -1   33 *********************************
  0   36 ************************************
  1   32 ********************************
  2   23 ***********************
  3   40 ****************************************
  4   37 *************************************
  5   20 ********************
  6   39 ***************************************
  7   30 ******************************
  8   27 ***************************
  9   21 *********************
 10   31 *******************************
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